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CONTENTS

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THE GENE AND THE ONTOGENETIC PROCESS[1]

The problem of the relations of genetics and physiology of development is essentially a modern problem much discussed of late, and recently expounded in very concrete form in Goldschmidt's "Physiologische Theorie der Vererbung." It was not visualized by Darwin and by Weismann, because, for each of them, the theory of development included the theory of heredity. However, their theories of determinants, both of development and of heredity, died on the field of battle in the "nineties" and the early years of this century. Mendelism arose, and the theory of heredity became by degrees the modern doctrine of the genes with its denial of *representative* particles and unit characters; but the determinant theory of development died childless, with no successor except a field of investigation which no single theory can compass.

Since Weismann, physiology of development and genetics have pursued separate and independent courses. Have these courses increased the divergence which became pronounced in the nineties of the last century when the untenability of a determinant theory of development was demonstrated experimentally to the point of silencing all former adherents? Or, on the other hand, has the immense progress made in both disciplines in the present century been of such a nature as to lead to an expectation of their ultimate reunion? There can be no doubt, I think, that the majority of geneticists, and many physiologists certainly, hope for and expect a reunion. The spectacle of the biological sciences divided permanently into two camps is evidently for them too serious a one to be regarded with satisfaction. The essays of Spemann, of Morgan, of Jennings and of Goldschmidt are symptomatic. The voice of Bateson on the other side, now unhappily silenced, is relatively lonely. I do not perhaps need to protest my love for both fields of work, nor my admiration of the investigations that have so widened our biological horizon in recent years. I would ask only to consider with you their mutual relations, whether to one another or with a *tertium quid* in the organism.

What are the reasons why geneticists and physiologists alike agree that there is present promise of a

[1] Evening lecture delivered at the Marine Biological Laboratory, Woods Hole, Mass., July 22, 1927.

reunion of genetics and physiology of development? The promise arose with the gradual abandonment of the essentially determinant point of view in genetics expressed in the theory of unit characters, and its replacement by the factorial hypothesis or gene theory, the most important general advance of genetic theory of our time. This advance at once broke down—or at least appeared to break down—an impassable barrier: so long as the theory of genetics continued to be determinant in character, there could be no common meeting ground with physiology of development which had definitely passed that standpoint. The promise of reunion also rests, I think, on confusion of the physiological conception of heredity as repetition of life histories, and the essentially statistical examination of the reappearance of differentiating characters in successive generations which constitutes genetics. These are really very different things. There is also the justified feeling that such a pragmatically valuable conception as that of the genes must have profound physiological applications, but that again is a very different question—or perhaps only a small part of the question.

These mutually supporting ideas are undoubtedly very convincing; otherwise we should not have so outstanding a geneticist as Morgan maintaining that the application of genetics is one of the two most promising methods of attack on the problems of the physiology of development (1926), nor so outstanding a student of the physiology of development as Spemann pledging the aid of his science to genetics, nor should we find Goldschmidt devoting all his strength to the elaboration of a theory comprising development as well as genetics in its scope, and based throughout on the conception of the gene.

Let us then inquire into the prerequisites of an alliance between genetics and the physiology of development. Since genetics has become quite a unitary science, and physiology of development is at most a field of work, we can best proceed by an examination of the necessary concepts of the latter followed by an inquiry into reciprocal relations for each concept.

I. Concepts in the Physiology of Development

The necessary concepts that I propose to consider are those of the germ, of individuation, and of differentiation in its two aspects of embryonic segregation of potencies and of realization of potencies.

1. The concept of the germ is that of an organic entity of a relatively simple and undifferentiated character capable of producing a more or less specific organism of a relatively complex and differentiated order. The concept of the germ has thus of necessity somewhat of a teleological cast, which is seen in the implications of theories of development and heredity.

The germ exhibits the duality of nucleus and cytoplasm; the geneticist has taken the former for his field, the embryologist the latter, neither arbitrarily, but both of necessity, even while both admit that neither in genetics or in embryology does either operate alone. The germ is the basis of all happenings in embryology and in genetics. A change in genetic germinal composition means changes in development all along the line. No physiological event can be the same in two germs of different genetic composition; the divergence of characters that so emerges is then correctly referred to the initial germinal difference. Let it be admitted once for all that genes are concerned in the genesis of all characters of the organism.

2. The germ is physiologically integrated as an individual at all stages. It may be first merely a cellular individual, then a definitely polarized individual with one or more axial gradients; as development proceeds, specific correlations, including those of definitely nervous and chemical natures, make their appearance. In short, the physiological principles upon which integration depends undergo differentiation, in the sense of progress from relatively simple and few to relatively complex and many, during development. While individuality may thus *appear* to grow, it is in reality complete at all stages, only the means to its realization changing and multiplying with growing complexity.

3. Successive stages of development are marked by increasing complexity of organization, and each stage has its own characteristic features. The term "differentiation" is commonly used to cover this whole series of events. We can, however, distinguish two logically very different series of phenomena overlapping in time to a great extent. The first, which is especially characteristic of early stages, is a process of origin of definitely determined loci (primordia), each with a specific potency. This process I propose to call in what follows *embryonic segregation,* on account of the resemblance of its sharply alternative character to Mendelian segregation, to which however it has no other observable resemblances. It is a process of origin of limited potencies. The second, which is especially characteristic of later stages of the life history, involves the realization of the potencies isolated in the final terms of the segregation process, thus involving histogenesis and definitive functional development.

Embryonic segregation may be characterized by the following features:

1. Its action proceeds from the more general to more special in a definite sequence which is both hotomous and discontinuous.

2. This results in a progressive genetic restriction, a more or less fixed kind, in the primordia thus ablished.

3. These processes exhibit definite order, (a) in e, (b) in space, *i.e.*, localization in the whole, and) of determinate qualities coordinated both in ce and in time.

4. There is a final term in each of the branches, ich is followed by histogenesis and definitive funcnal differentiation, though certain terms (or nches) remain open throughout life. We may s distinguish closed and open terms throughout life history with reference to embryonic segreion.

Comments are in order upon the above characterizans, for they concern I believe the most vital features embryological development.

The dichotomous and discontinuous character of process is well illustrated by cell-lineage, and ecially by Wilson's and Conklin's masterly analyof this determinate form of cleavage. Celleage shows us daughter cells with such different ospective potencies as ectoderm and entoderm, or erior and posterior quadrants of the embryo; and experimental analysis shows us that these prospece potencies are also genetic restrictions. The gin of these potencies in a single cell-division is hotomous, and the discontinuity appears in their rply differentiated genetic restrictions. This prinle runs through all varieties of embryonic developnt, even if under different forms, as a great variety experiments shows (*cf.* Spemann and Hoadley).

The space relationship in development, or the alization problem, exhibits itself with reference the entire organism of which each primordium is part; all primordia arise in definite areas, and ir realization may involve a secondary more pree localization. For instance, the potency of the s of the eye in amphibians lies in the embryonic idermis at a definite stage of development, but the finitive localization within this area is not fixed til adjustment is established with the optic vesicle. e possibility of normal development depends among er things upon flexible, but finally precise, adjustnts of localization of specific parts everywhere in e embryo. The situation implies correlations and luctions dependent upon extraorganic and intraganic factors, and such relations have been demonrated over and over again in experimental embrygy. Child's gradient factors and principle of minance are striking examples of analysis of facrs of localization in the early embryo. The problems of localization, considered as such, would appear to be susceptible to physiological analysis.

Before examining the time process in development we must first consider the principle of embryonic induction of which we are hearing so much, and ask what it may be expected to explain and what it may not be expected to explain in the physiology of development. Environmental relations are very evident in many cases of embryonic localization, and it is natural to look for them in all cases. The origin of the lens of the eye as an induction in the embryonic epidermis exerted by the optic vesicle is a well established example. The experiments show that at this stage the epidermis of the head region, at least, possesses two potencies, however they may have arisen, and only two, *viz.*, to form lens cells, or epidermal cells which have lost the power of lens formation; which shall be realized in the case of any cell or group of cells depends on induction, in this case by the optic vesicle. Note that this potency exists only for a relatively brief period of time; once accomplished, it can not be repeated. In Driesch's terms the lens is positively restricted, the epidermis negatively restricted. Or take as another example the beautiful experiments of Spemann and his students. They show, for instance, that the ectoderm of the *gastrula* of Triton has two potencies and only two so long as it remains *in situ, viz.*, to form neural epithelium or general epidermis, each thereafter positively and negatively restricted. The experiments that show, that in this case the decision rests with the archenteron, is one of the biological triumphs of our time.

Examples might be multiplied, but all would serve to show that induction produces only the phenotype[2] for which ontogenetic segregation has prepared the way; that the specificity of the response lies in the stage and locus, not in the inducing agent; and that the possibilities for any induction are only two in number.

This simple situation is often confused by two prevalent ideas—the one that potencies may be more

[2] W. Johannsen, who introduced the word "phenotype," applies it not only to statistically determined modes in a population, but also uses it to designate in their entirety the personal qualities of any individual as given. (Elemente der exakten Erblichkeitslehre, dritte Aufl. 1926, pp. 162–163.) It can hardly be regarded as an extension of Johannsen's definition to apply it to any stage of the organism as the purely descriptive condition of all its parts. The usefulness of this term in embryology is to abstract from a given stage all implication of future potency. "Phenotypical realization," therefore, explains itself as including the immediate circumstances that condition a given embryonic phenotype.

than two at one time and place; the other that the inducing agent may have determining value, *i.e.*, may be a so-called formative stimulus.

The first confusion arises from taking remote potencies into simultaneous consideration with immediate ones. Thus the embryonic ectoderm of a mammal may be said to have the potencies of nervous system, lens, hairs, glands and epidermis. But these potencies do not exist simultaneously; when the ectoderm has the potency of forming nervous system, it does not have the potency of forming lens or any primordium of later origin. After the nervous system is segregated the ectoderm has lost the potency of repeating the process, and has acquired two new potencies and so on to the end of the chapter. Only two potencies at a time, and these realizable by induction. The same principle holds throughout the life history.

Secondly, there is no such thing as a formative stimulus in embryonic development. Embryonic induction is no different in principle from induction of muscular contraction, or of nervous conduction or of glandular secretion. The nature of the response is conditioned by the immediate potencies of the responding system, and the nature of the stimulus is secondary. We are much more familiar with the inductions of differentiated tissues, and are unaccustomed relatively to the idea that the ectoderm of the gastrula for instance is giving its specific form of reaction when it forms a medullary plate; or the lens epidermis when it forms lens. Both because the idea is relatively unfamiliar, and also because the inducing agencies have been but little studied up to the present, we are apt to conclude that a new principle is involved, and that environment plays a different rôle in embryonic development from what it does in adult life. But such a conclusion introduces endless confusion, and has not, in an experimental way, clarified any situation.

It is the non-repetitive character of the responses of embryonic segregation that really sets them apart from functional responses, such as the contraction of a muscle cell, for instance, which are repetitive. But this in itself does not assign a different rôle to environment in the two categories, as some have assumed.

There are theoretical viewpoints concerning development that neglect the processes of induction, and visualize only the more or less hypothetical processes of chemo-differentiation that run parallel with the ontogenetic current. Thus, visible substances in the unsegmented egg have been termed formative stuffs, on the assumption that they are the agencies of subsequent differentiations. When it was shown that visible substances of such kinds are not essentials of the specific local differentiations in which they normally occur, by the occurrence of properly localized differentiation, in spite of their displacement by centrifugal force, the theory reverted to invisible substances retaining their typical localization. Criticism must then revert to the *type* of explanation, against which it must be said that if there are as many kinds of purely hypothetical formative stuffs, as there are formations (*cf.* Goldschmidt), and so long as their physiological action is postulated only by their names, the view becomes indistinguishable from the determinant theory of Weismann. The theory does not become physiological by naming such hypothetical substances hormones (Goldschmidt), for these then become endowed with the same mysterious properties. Again such an ultra-simplified conception as the "autocatalytic theory of development," also primarily "chemical"—if any one does indeed hold such a theory, as is rumored—does no more than visualize a single aspect of growth processes in the organism to the exclusion of the really essential aspects of development.

It is a mere truism that the energy of development is furnished by metabolism. I do not, however, regard the rôle of metabolism in development as essentially different in any stage from what it is in the adult. We know, in fact, relatively little concerning embryonic metabolism save its variations in rate in the time sequence of ontogeny measured by growth, or other criteria. We know also (or at least infer), by various rough indications, that metabolism varies qualitatively according to stage and locus. These differences, however, can not be regarded in general as determining factors of the course of development. They are primarily chemical indicators of differentiations already accomplished. But, once accomplished, they become part of the intraorganic environment and function as such in development, whether as hormones or in numerous other ways.

So much concerning ontogenetic segregation. The other aspect of differentiation realization of potencies—(histogenesis and functional differentiation)—follows the final stages or terms of segregation in the various branches of the ontogenetic tree when potencies are limited to a single one. Such terms of the ontogenetic process may, therefore, be called *closed terms*. They may usually achieve their realization, to a considerable extent at least, in isolation from the remainder of the organism. Hence they are said to develop by self-differentiation. Such final terms are scattered all along the life history from a very early stage indeed. This situation, which is at least a very common one, differs from that in earlier stages of embryonic segregation, in which there are always two possibilities open to induction.

It is vastly important, however, that in the mo

ile types of animals, at least, such as those of our n phylum, certain cells retain a double potency oughout life. These are the freedom-giving *open ms* of the ontogenetic process. A very beautiful mple of this is found in the feather germs of ually dimorphic birds, which according to alterna- e hormone conditions may blossom out as male or nale feathers throughout life. The nervous system also such an open system *par excellence.*

Let us return to the time aspect of development ich concerns the sequential order of embryonic regation. It is measured not by time units, but events. At each stage of the ontogenetic process ecific forms of reaction, whether of the whole or its segregated parts, occur. The order is quite variable, at least within any given system, and, far, this order has not been experimentally in- rted in any of its parts.

On the physiological side there is no adequate eory of the sequential order of ontogenetic segre- tion. At the most we can speak only vaguely, and rely by analogy, of chain-reactions in a complex stem; or if we take biological categories, and rase the problem in terms of senescence for in- nce, whether we adopt a nucleo-cytoplasmic rela- n theory, or a theory of accumulation of inactive oducts (or whatever else may be possible) there nothing to correspond in specific character, or in anifoldness, even in general principle, to the defi- tely ordered sequence of developmental events.

Granted that we may resolve development into a ries of inductions that come to be better and better own, more and more fully analyzed, and a series internally determined events or processes with ly one typical outcome, is it not still entirely known why these inductions and events should be typically various and discontinuous at different mes in the life history? Granted that we may learn definitely more about specific constructive metabo- sm, and about growth processes of the entire organ- m or of its parts, do not the same considerations pply to these processes so far as they are various different stages? All current theories in the physi- ogy of development presuppose in fact a basic ocess of embryonic segregation in due sequence in me.

This scanty survey of a few triumphs of physiology development, with its large lump of pessimism at e end, illustrates the impossibility of a single theory development. Ontogeny is a moving equilibrium, hich involves all fundamental physiological process each stage, and it can no more be envisaged under single formula than can the conception of life self. Genetics on the other hand is subsumed under single formula.

II. Relation of Genetics to the Physiology of Development

Now in which of these general situations of embryonic development does the theory of genetics play a rôle? or offer substantial assistance? As a matter of fact does any experimental embryologist use the conceptions of genetics in his work? If not, is it because the principles of genetics serve some entirely different situation? Let us proceed systematically.

Does genetics help in the conception of the germ? I think we may say that it certainly does, if the germ indeed contains "hundreds of thousands" of "different kinds of packets of chemicals" "massed in a haphazard way but arranged in a definite manner." Certainly no embryologist would have discovered that by his own unaided efforts. Admitting for the sake of the argument the essential validity of this addition to our actual cytological knowledge, does it aid in the experimental attack (as working hypothesis or otherwise) on the problems of the physiology of development? To answer this question we must examine each of the other concepts of the physiology of development.

Does it aid in the concept of individuation? I shall answer this question briefly because I think we shall all agree that it does not; that on the contrary it tends to confuse it. What principle is adequate to hold such a swarm within the bounds of individual being, or to direct their work! Individuation is clearly an environmental relationship, mediated through the cytoplasm, not through the nucleus.

With reference to the processes of embryonic segregation, genetics is to a certain extent the victim of its own rigor. It is apparently not only sound, but apparently almost universally accepted genetic doctrine to-day that each cell receives the entire complex of genes. It would, therefore, appear to be self-contradictory to attempt to explain embryonic segregation by behavior of the genes which are *ex hyp.* the same in every cell.

Goldschmidt has, however, attempted to do this. He has in fact postulated two mechanisms, which seem to be independent of one another in a logical sense, and which he has not clearly interrelated. The first is a theory of quantitative regulation of the genes, according to which each gene of the thousands concerned enters into activity at a rate, and therefore at a time, proportional to a precisely regulated initial quantity. This of course presupposes an underlying mechanism adequate to almost ultraphysically precise regulation in the germ, for which no model can be suggested; at the most it shifts the difficulty one step farther back. The second is the lock-and-key theory of substratum (cytoplasm) and gene, *viz.,* that each gene

reacts only with a specific substratum, from which it follows as corollary that specific substrata are always present at the appropriate time and place. This seems to me to postulate the process which it is invoked to explain, *viz.*, ontogenetic segregation and the time relationships of specific events. It is also inconsistent with his postulates of sex-genes which control, and therefore must react with, the greatest diversity of chemical processes in all parts of the organism; and of other genes similarly controlling diverse characteristics. Both conceptions postulate specific genes for all differentiating characters of each stage, and latency for all genes except those postulated for the specific event. In its essence the theory is deterministic, and not consonant either with sound physiology or sound genetics.

Apart from these conceptions I do not know of any sustained attempt to apply the modern theory of the gene to the problem of embryonic segregation. As the matter stands, this is one of the most serious limitations of the theory of the gene considered as a theory of the organism. We should of course be careful to avoid the implication that in its future development the theory of the gene may not be able to advance into this unconquered territory. But I do not see any expectation that this will be possible, even in principle, so long as the theory of the integrity of the entire gene system in all cells is maintained. If this is a necessary part of the gene theory, the phenomena of embryonic segregation must, I think, lie beyond the range of genetics.

Geneticists have, however, brilliantly demonstrated that genes are concerned in phenotypical realization at different stages of the life history, and it is therefore a reasonable postulate that this is true of all phenotypic realization. We come here, therefore, to the specific problems in which genetics and physiology of development really meet. There can be no reasonable doubt that any definable character whether of a morphological, physiological, or psychological (behavioristic) nature may be treated by methods of genetics (*i.e.*, considered statistically with reference to modes of recurrence in successive generations), as well as by methods of physiology. Thus in addition to the numerous morphological characters, for which they are already demonstrated, genes may also be posited of all physiological and behavioristic characters that can be shown to mendelize. Similarly there are genes for characters of the ovum and of the larva; and, by inference, there can be a complete genetics with corresponding genes for each stage of development.

The genetic problem thus differs from the embryological problem, inasmuch as any definable character at any time in the life history may be treated as final, according to the methods of genetics, and genes presumably could be located on the chromosome map.

What then in the process of phenotypical realization would be the physiological status of the gene? Apart from analogical points of view in which for instance the action of genes is compared to that of enzymes, the approach to this problem may be made by two roads, (1) through experimental modification of the environment of known genotypes and comparison of resulting phenotypes with control cultures; and (2) through comparison of the action of varieties of gene combinations on known characters of the organism.

Morgan, for instance, cites a mutant of Drosophila studied by Mrs. Richards, differing from the normal by but a single gene, which when raised in an ice chest has one or two, or even all, of its legs doubled, but if reared at room temperature none; "at room temperature no flies result with more than six good legs." In 1911 Baur cited several analogous cases in his text-book of heredity, and pointed out that in heredity in general what is inherited is not the character as such, but only a definite form of reaction to environment.

If this is a true generalization, the underlying postulate is again the ontogenetic substratum, which this form of analysis of the action of genes does not attempt to elucidate. What is won for physiology of development by such examples is a heightened sense of the dependence of physiological reactions upon the genetic foundations of the reacting system, but not additional insight into the developmental problem.[3]

The method of comparing the action of varieties of gene combinations upon known characters of the organism under constant or varied conditions of environments is the oldest method of analyzing the mode of action of genes in development, and it appears to me to be the most promising method at the present time. The study of the phenomena of multiple allelomorphism, the observed results of gene deficiency resulting from loss of a piece or all of a chromosome, and the results following from triploidy or greater additions, whether of one chromosome or the entire chromosome complex, especially as presented by the Columbia University School of Geneticists, appear to me to throw much light on the problems of the physiology of development of the fly.

[3] Another form of environmental problem in genetics is found in attempts to modify the genes in the germ-cells directly, the indicator being the phenotypes resulting from such treated germ-cells compared with controls. This is, however, a problem in pure genetics and need not interest us farther.

terms of the underlying ontogenetic segregations. There is no time to rehearse these splendid additions to our biological knowledge, and I shall not attempt to appraise the theory of genic balance which appears so clearly to emerge.

More than this should, however, be said: one can not imagine at the present time any other experimental technique that would even remotely approach in delicacy of treatment to the superlative refinement of modifications of the gene system that the genetic method renders possible. It is an indispensable method for phenotypical analysis whether in a genetic or a physiological sense.

Its scope is, however, limited in two ways: in the first place at whatever stage of development a character may be selected for examination, and whatever the nature of the character, it must always, so far as genetic method is concerned, be treated as a finality. It has no past, except the genes postulated as a result of their appearance in previous generations—and no future. The genetic method reveals, *alpha,* the gene, and *omega,* the final term. The second limitation of genetics, considered as an approach to phenotypic realization is, of course, the failure of any direct physiological analysis of the postulated genes. This need not be a permanent limitation, but it seems to me that *at the present time* it is a definite limitation.

I suppose that geneticists would agree that there is a clear possibility that the future development of the subject may result in a considerable reduction of the number of genes necessary to be postulated. Morgan's conclusions that a single gene may be concerned in a multiplicity of characters, both in time and in space, and that a multiplicity of genes may be concerned in each character are indeed steps towards simplification. But, granted the extremest simplification, genetics could at the most explain the special quality of characters associated with particular genes or combinations of genes at given stages and loci of development, but never why the same genes are associated with different characters at different stages and in different loci.

The present postulate of genetics is that the genes are always the same in a given individual, in whatever place, at whatever time, within the life history of the individual, except for the occurrence of mutations or abnormal disjunctions, to which the same principles then apply. The essential problem of development is precisely that differentiation in relation to space and time within the life-history of the individual which genetics appears implicitly to ignore.

The progress of genetics and of physiology of development can only result in a sharper definition of the two fields, and any expectation of their reunion (in a Weismannian sense) is in my opinion doomed to disappointment. Those who desire to make genetics the basis of physiology of development will have to explain how an unchanging complex can direct the course of an ordered developmental stream.

There remains to be mentioned the oft-noted phenotypic identity of environmental varieties of given characters and of genic modifications of the same characters. One need only call to mind the bar-eye series in Drosophila or Johannsen's pure lines of beans. Many similar cases exist in the phenomena of sex-differentiation, which appear to be conditioned by genes in insects, and hormones in birds, but which nevertheless exhibit comparable diversities and similar functions in the life history.[4] How are we to understand this except on the assumption that both act on a given ontogenetic process?

Physiology of development and genetics both teach us the same lesson, *viz.,* that at the foundation of every phenotypic event there is an unanalyzed ontogenetic process, which expresses itself in time by qualitatively different types of reaction whether to the environment, or to the gene, or to both combined. This is the unrecognized presupposition of all studies in either field. I must emphasize that there is nothing in the current principles of genetics or of physiology that gives us the least clue to the nature of embryonic segregation in its time sequence, which constitutes the ontogenetic process in its strictest meaning.

In this conclusion I find myself in agreement with Bateson, who, in his last publication, says:

"Cytology is providing some knowledge, however scanty, of the material composition of the cell, but of the nature of the control by which a series of orderly differentiations is governed we have no suggestion" (p. 234), and again

"Throughout all this work, with ever-increasing certainty, the conviction has grown that the problem of heredity and variation is intimately connected with that of somatic differentiation, and that in an analysis of the interrelations of these two manifestations of cellular diversity lies the best prospect of

[4] The gene may of course be regarded as having secondary modes of action, to the extent that it is a factor in the realization of the intraorganic environment in all of its aspects. If, for instance, we make the assumption that in birds the genic constitution determines the nature of the sex-hormones produced by the individual, then the known action of the sex-hormones on head-furnishings, plumage, spurs, reproductive tract, growth and behavior may be regarded in a certain sense as secondary modes of action of the genes. But no example would serve better to show that both primary and secondary effects are functions of the life history as to their incidence.

success. Pending that analysis, the chromosome theory, though providing much that is certainly true and of immense value, has fallen short of the essential discovery" (p. 235).

However profound our present ignorance of the method of ontogenetic segregation may be we are nevertheless bound to conceptions of strict determinism concerning the phenomena involved. The phenomena of genetics and of embryonic induction exhibit strict experimental determinism, which would be impossible if the ontogenetic processes on which both depend were not deterministic also. Nothing that has been said in this essay should be interpreted in any contrary sense. The processes of embryonic segregation are open to observation and experiment equally with the processes of genetics and of embryonic induction. My contention is merely that we have no present working hypothesis effective in this most fundamental aspect of the life history.

The dilemma at which we have arrived appears to be irresolvable at present. It is the apparent duality of the life history as exhibited in the associated phenomena of genetics and ontogeny: on the one hand the genes which remain the same throughout the life history, on the other hand the ontogenetic process which never stands still from germ to old age. It is no confession of weakness that we should admit our inability to form a picture of life-processes that have taken longer to evolve than the mobile crust of the earth itself. Instead of distorting our workable conceptions to include that which they can in no wise compass, may it not be profitable, for a while, to admit that more lies without than within our confines of mechanism and statistics? If physics and chemistry will not be complete until they have explained the action of their units in living matter, that is after all their affair. Certain it is that physics and chemistry have no place among their categories for the ontogenetic process and *a fortiori* for the phylogenetic. Why not surrender ourselves, in consideration of these problems, to the current of more naïve biological categories?

References

1. Bateson, Wm., 1926. Segregation: Being the Joseph Leidy Memorial Lecture of the University of Pennsylvania, 1922. *Journ. of Genetics* 16, 201–235.
2. Bridges, Calvin B., 1922. The Origin of Variations in Sexual and Sex-limited Characters. *Am. Nat.* 56, 51–63.
3. Goldschmidt, R., 1927. Physiologische Theorie der Vererbung, 247 pp. Berlin, Julius Springer.
4. Jennings, H. S., 1925. Promethus, or Biology and the Advancement of Man, 86 pp. New York, E. P. Dutton & Co.
5. Morgan, T. H., 1926. Genetics and the Physiology of Development. *Am. Nat.* 60, 489–515.
6. Spemann, H., 1923. Zur Theorie der tierischen Entwicklung. Rektoratsrede, Freiburg.
   1924. Vererbung und Entwicklungsmechanik. Z'tschr. f. ind. Abst. und Vererbungslehre 33, 272–93.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

NEWSPAPER REPORTS ON THE MEETINGS

It is commonly remarked that the general public, throughout the reading world, is increasingly interested in the progress of science. Practical achievements, such as inventions and directly useful discoveries, have long interested people not specially trained or engaged in scientific work, for such achievements affect the daily routine of ordinary life, but the last decade has witnessed a remarkable development of public interest in the more easily discussed aspects of scientific research and scientific progress. Intelligent people now wish to read about advances in knowledge that do not apply directly to their daily activities, and this desire appears to be rapidly spreading and becoming more intense. The technological or applied aspects of scientific progress remain, of course, the subjects of most popular discussion, and superficially descriptive science, including mere observational facts without discussion of relationships, naturally constitutes a large part of what is prepared for popular scientific reading.

All three of these different aspects of scientific knowledge — observational facts, applications that economize time or simply make life more pleasant or more gainful in the financial way, and theoretical or philosophical advances in interpretation or appreciation of relationships between objects of knowledge — are receiving much more popular attention than ever before. In this and many other countries writers for newspapers and magazines and for radio talks, and also those who have charge of museums, are increasingly occupied with the popular presentation of science material. Many writers are primarily so engaged; this sort of work is becoming an important branch of the teaching profession in a broad sense. The demand increases more rapidly than the supply, which may be taken to indicate that the reading public really desires all kinds of science material presented in simple fashion.

For many years the American Association for the Advancement of Science has tried to facilitate the popular reporting of its meetings, but it is only recently that its efforts have been met half-way by the

COLUMN-INCHES OF SPACE GIVEN BY EIGHT NEWSPAPERS TO REPORTS OF THE FIFTH PHILADELPHIA MEETING

Sections	Philadelphia Evening Ledger	Philadelphia Public Ledger	Baltimore Evening Sun	New York Times	New York American	New York World	Boston Transcript	Christian Science Monitor	Total
A. Mathematics				9.25	7.25	13.25			29.75
B. Physics	15	3.50	9.75	17.50	17.50	12	62.75	1.25	139.25
C. Chemistry			4		1.50	1.50	6.50		13.50
D. Astronomy	6.25	23.75	24	17	32.50	41.25	23.25	11.25	179.25
E. Geol. and Geog.	26.75	21.50			2		12	30	92.25
F. Zool. Sciences		14	21	32.25	3.75	1.25	21.50	1	94.75
G. Bot. Sciences		4.50	4.25	2.50		1.50	26.25	26	65
F–G. Additional zool. and bot. material, not separated			16	31	8.25	6	8.50	2	71.75
H. Anthropology		2.75	11.50	15	4.25		5.75	14	53.25
I. Psychology	6.75	9.50	17.50		11.50	5.50	34.75		85.50
K. Soc. and Econ. Sciences	5.25	42.50	7.75	5	19.50	6	52.50	34	172.50
L. Hist. and Philol. Sciences		12.50		31.50		8	13.25		65.25
M. Engineering		8							8
N. Medical Sciences		5	6.25	7.50	7	8	51.25		85
O. Agriculture			1.75			2.50	12.50	13.50	30.25
Education and Science in general	14.75	87.75	3.50	7.25	16	6.75	16.25	42	194.25
Total	74.75	235.25	127.25	175.75	131	113.50	347	175	1,379.50

news writers for the press. At the great Chicago meeting in 1920 the few press representatives who were present were apparently not greatly interested in attempting to report the scientific material presented at that meeting. Those were times when editors seemed generally to desire amusing incidents and slap-stick comedy at the expense of science workers, and little energy was expended to present science in a popular way. The public had little opportunity to learn what science workers were trying to do. Such an attitude on the part of the daily press aroused antagonism in the minds of the speakers at meetings of workers in science and made it more difficult for a news writer to secure useful material, even when that was attempted.

Beginning with the Toronto meeting in 1921, these conditions have changed rapidly and very thoroughly. Many of the most able writers of popular science have attended the recent meetings and have gone more than half-way in meeting the attempts of the association to get science and the scientific method of work before the public. Press reports of the meetings have become increasingly more thorough and more adequate. The antagonism of science workers has now largely disappeared and leaders in research are now generally willing to aid the representatives of the press in this important work. At the same time, the association has put forth greater effort in this direction. Hundreds of abstracts of papers to be presented at the meeting are secured beforehand from the speakers and are placed at the disposal of the representatives of the press, for release at proper times. Arrangements are also made to facilitate the interviewing of science workers by press representatives. Photographs of prominent speakers are supplied to the press in many instances. A special news office has been made a part of the annual meeting, in charge of a news manager who represents the association.

Several of the great American daily papers usually have special representatives detailed to report the association meetings, representatives who are masters of the art of popular scientific presentation, and the same is true of several news agencies. Science Service, in the founding and operation of which the association has been specially interested, has been well represented at recent meetings and its work has been very helpful.

The last annual meeting, at Philadelphia, may be taken as an illustration of the present status of the

reporting of association meetings in the daily press and the data given in the following table will be of interest in this connection. This table has been prepared by Mr. W. Eric Drake, of the Washington office of the association. Eight leading newspapers that gave special attention to the meeting were selected and the amount of space given by each of them to news from the meeting, for each branch of science and for science in general, was determined in terms of column-inches. Illustrations were not included; they are generally half-tone reproductions of photographs of eminent men, though pencil sketches are sometimes used. The results are the data given in the table, the names of the eight dailies being shown at the top. The several fields of science are shown in the first column, referring generally to the sections of the association. But it will be noted that the F-G category includes material of zoology and botany that could not be readily separated. Also, the last category of the list is, for the same reason, made to include both general science and the special field of education (Section Q). To avoid these combinations, which are perhaps not logically satisfactory, would have required more time and attention than seemed to be justified in such a little study as this.

Members of the association and of the associated societies who are interested in this aspect of the popularization or humanization of science will find interest in the fact that the permanent secretary's office now prepares regularly a scrap-book of newspaper clippings for each annual meeting, each clipping being marked to show the name and date of the paper in which it appeared. The clippings are attached to strong sheets, which are finally bound in permanent form. These scrap-book volumes may well be of considerable interest as time goes on. They form a part of the association archives. Any one who cares to examine the scrap-books may do so at the Washington office at any time.

Turning to the table of measurements of space given by the newspapers to reports of the fifth Philadelphia meeting, it will be noticed that all eight papers together devoted nearly 1,400 column inches to the sessions. The largest space (347 in.) was given by the Boston *Transcript* and the next largest (235 in.) by the Philadelphia *Public Ledger*. As to the amounts of space devoted to the association sections by all papers together, it appears that Section D (Astronomy) was most generously treated and that nearly as much space was devoted to the programs of Section K (Social and Economic Sciences). Section B (Physics) received a large amount of space. If zoology and botany were combined (items F, G and F–G in the table) the resulting total (232 in.) would be larger than any other in the table, but the separate items are not very large.

If one studies the general program of the meeting it becomes clear that at least three factors take part in determining the amount of space devoted to any branch of science: the number of papers presented in the given branch; the adaptability of the material presented, with reference to popular accounts such as are suitable for newspaper publication; and the degree of reportorial or editorial interest in the given branch. The figures given in the table are not to be taken to represent any single one of these factors, but in some cases one factor appears to have dominated while in other cases another factor seems to have been most pronounced. Mathematics is perhaps least adaptable to popular presentation and only three of the dailies attempted to do anything with this field. On the other hand, all of the eight dailies dealt with physics and astronomy as well as with social and economic science. Special editorial interest, or lack of interest, in certain fields appears to be indicated in some cases.

Burton E. Livingston,
Permanent Secretary

SCIENTIFIC EVENTS

RESEARCH FELLOWS AT YALE UNIVERSITY

Investigations into scientific and literary problems are being made this year under Yale University auspices in Greece, England, Scotland, Germany, Austria, Belgium, Russia and Africa, according to an announcement by Dean Wilbur L. Cross, of the Yale Graduate School.

Eight holders of Sterling fellowships, the funds for which were provided by the trustees of the estate of John W. Sterling, are carrying on their work abroad. These include: Dr. Hempstead Castle, who is in Europe collecting material for a world monograph of the known species of radula; Dr. Filmer Stuart Cuckow Northrop, who has been studying in Berlin and Zurich the generalization beyond the general theory of relativity, and Dr. Prescott Wilson Townsend, who has been continuing his archeological research in northern and western Africa.

John Wynn Gillespie, M.A., Stanford University, and Victor Pietschmann, University of Vienna, who are the holders of Bishop Museum Fellowships, are conducting research in botany and zoology in the islands of the Pacific. Mr. Gillespie is concentrating on the Fiji and Samoa Island groups, and Dr. Pietschmann on the New Hebrides and Loyalty Islands.

Six of the scholars awarded Sterling fellowships

for research at Yale University this year are of foreign birth. These include Dr. Blythe A. Eagles, of the University of Toronto, who is conducting research in biochemistry; Amihud Crasovsky, of Jaffa, Palestine, a graduate of the University of California, who is in the department of botany; Catherine L. T. Lucas, B.Sc., University of London, M.Sc., London School of Tropical Medicine and Hygiene, who is in the department of zoology; Paul Slavenas, of the University of Lithuania, Kaunas, Lithuania, who is conducting research in astronomy, and Desire T. Veltman, of the University of Holland, of Dutch citizenship, who is in the department of philosophy. Mr. Dirk Brouwer, who is assistant at the observatory at Leiden, Holland, is doing work in astronomy at Yale.

The Lilly research fellowship in organic chemistry has been awarded this year for the first time. The recipient is Dr. Richard Helmuth Fred Manske, Ph.D., Manchester University, England, 1926. Dr. Manske is conducting research in organic chemistry under Professor Treat B. Johnson.

Among the visiting members of the faculties of other institutions who are making use of the facilities of the university are, Professor Magumi Eri, of the Higher School for Women, of Nari, Japan, who is working under Professor Ross G. Harrison in the department of zoology; Professor C. C. Chen, Ph.D., Yale, of Shanghai College, who is undertaking special research in bacteriology, and Miss Isabella Gordon, Ph.D., University of London, from Scotland, is doing research work in zoology and anatomy.

PUBLIC LECTURES ON ASTRONOMY

A SERIES of five "Open Nights," under the auspices of the Bond Astronomical Club, are being held at the Harvard College Observatory. A short non-technical talk is followed, when the weather permits, by telescopic observations of celestial objects. Exhibits showing the work of the observatory are explained by members of the club. Tickets for these open nights must be obtained in advance. There is no charge for admission. The lectures begin at 7:45 P. M. The dates, titles of lectures and the speakers are as follows:

Oct. 10.—*The full moon and the eclipsed moon.* Dr. W. J. Fisher.

Oct. 13.—*The winter constellations.* Dr. Cecilia H. Payne.

Oct. 18.—*The planets.* Mr. Leon Campbell.

Oct. 24.—*New stars.* Dr. Annie J. Cannon.

Oct. 27.—*Star clouds and nebulae.* Professor Solon I. Bailey.

The Astronomical Society of the Pacific has arranged two series of lectures for the coming season, one of six lectures at Culbertson Hall, Pasadena, and one of six lectures at the Public Library, Los Angeles. All of these are free to the public, although tickets, which may be obtained at the office of the Mount Wilson Observatory, will be needed for admission to all lectures in Culbertson Hall. All the lectures are to begin at 8:00 P. M. The subjects, dates and lecturers are:

Culbertson Hall, Pasadena

Sept. 29.—*Sun rays in the service of man.* Dr. C. G. Abbot.

Oct. 27.—*The exploration of space.* Dr. E. P. Hubble.

Nov. 17.—*Sun-spots.* Dr. S. B. Nicholson.

Dec. 15.—*Stars in action.* Professor A. H. Joy.

Jan. 26.—*How stars are made.* Dr. H. N. Russell.

Feb. 24.—*Our planet neighbors.* Dr. R. G. Aitken.

Public Library, Los Angeles

Dec. 15.—*Telescopes.* Dr. F. G. Pease.

Jan. 19.—*The sun.* Professor F. Ellerman.

Feb. 23.—*The solar system.* Dr. R. G. Aitken.

March 23—*Giant and dwarf stars.* Dr. F. C. Leonard.

CHANGES IN THE ORGANIZATION OF THE U. S. BUREAU OF STANDARDS

AN important change in the administrative organization of the U. S. Bureau of Standards, which it is believed will make for increased efficiency through a better grouping of the bureau's numerous activities, has been announced by the director, Dr. George K. Burgess.

Under the new arrangement, Dr. L. J. Briggs has been appointed assistant director in charge of research and testing, while Ray M. Hudson becomes assistant director in charge of commercial standards.

The regrouping is a recognition of the importance of standardization in the commercial world, this portion of the bureau's work having grown with great rapidity during the last few years.

As stated above, the bureau's activities will be divided into two main groups. The first, under the immediate supervision of Dr. Briggs, will include all the bureau's scientific research and testing, the development, construction, custody and maintenance of reference and working standards and their intercomparison, improvement and application in science, engineering, industry and commerce.

The second group, headed by Mr. Hudson, will include the supervision, direction, formulation and coordination of commercial standards, with particular reference to the needs of industry, involving the oversight of the division of simplified practice, division of commercial standards and part of the work of the division of building and housing relating to codes and

standards. In addition, the correlation of the work of the federal specifications boards with commercial practice, and liaison duties with other branches of the Department of Commerce and with other departments in questions relating to commercial standards will be included in this group.

Dr. Briggs will act as executive head of the bureau when the director is absent in the management and supervision of the administration, scientific and technical work. He will also continue as liaison officer on matters of aeronautics between the Bureau of Standards, the aeronautics branch of the Department of Commerce and other branches of the government.

DIVISION CHAIRMEN OF THE NATIONAL RESEARCH COUNCIL

The following chairmen of divisions of the National Research Council have been appointed for the current academic year:

Division of Federal Relations, George Otis Smith, director, U. S. Geological Survey.

Division of Foreign Relations, R. A. Millikan, director, Norman Bridge laboratory of physics, California Institute of Technology, Pasadena.

Division of States Relations, Raymond A. Pearson, president, University of Maryland.

Division of Educational Relations, Vernon Kellogg, permanent secretary, National Research Council.

Division of Physical Sciences, Dayton C. Miller, professor of physics, Case School of Applied Science.

Division of Engineering and Industrial Research, Elmer A. Sperry, president, Sperry Gyroscope Company, Brooklyn, New York.

Division of Chemistry and Chemical Technology, Frank C. Whitmore, professor of chemistry, Northwestern University.

Division of Geology and Geography, Waldemar Lindgren, professor of economic geology, Massachusetts Institute of Technology.

Division of Medical Sciences, Howard T. Karsner, professor of pathology, Western Reserve University.

Division of Biology and Agriculture, William Crocker, director, Boyce Thompson Institute for Plant Research, Yonkers, New York.

Division of Anthropology and Psychology, Knight Dunlap, professor of experimental psychology, the Johns Hopkins University.

SCIENTIFIC NOTES AND NEWS

The Harben gold medal of the Royal Institute of Public Health for 1928 has been awarded to Sir Ronald Ross in recognition of his eminent services to public health.

The Morris Liebmann memorial prize of $500, for 1927, has been awarded to Dr. A. Hoyt Taylor, of the Naval Research Laboratory, in Washington, according to an announcement by Dr. Ralph Bown, president of the Institute of Radio Engineeers, at a meeting of the institute held in the Engineering Societies' Building, New York, on October 4.

The Helen Culver gold medal of the Geographic Society of Chicago has been awarded to Dr. Gilbert H. Grosvenor, president of the National Geographic Society and editor of its magazine. The medal is for eminent accomplishments in the promotion of geography.

In recognition of his scientific work in the domain of pathology, Dr. Louis B. Wilson, of the Mayo Clinic, has been elected an honorary member of the Czech Medical Society of Prague. This society was founded by the famous physiologist, J. E. Purkinje, who was its president until his death in 1869.

Dr. Edward R. Weidlein, director of the Mellon Institute of Industrial Research, University of Pittsburgh, has been elected an honorary member of the Chemical, Metallurgical and Mining Society of South Africa.

Nature states that in the course of the Congress of the Institut International d'Anthropologie, which was held at Amsterdam from September 20 to 27, it was announced that the Prix Hollandais of the institut had been awarded to Miss Dorothy A. E. Garrod in recognition of her work in prehistoric archeology, and especially for her excavation of the cave at the Devil's Tower, Gibraltar.

Professor Vittorio Ascoli, director of the Clinica Medica of Rome, has received from the University of Edinburgh the degree of doctor *honoris causa.*

Professor Forest Ray Moulton, director of the department of astronomy of the University of Chicago, has resigned to become associated in an executive capacity with the Utilities Power and Light Corporation of Chicago.

Dr. Montrose T. Burrows has resigned as head of the research department of the Barnard Free Skin and Cancer Hospital.

C. F. Marbut, in charge of soil survey work, U. S. Bureau of Chemistry and Soils, has been appointed a member of the interbureau corn-borer committee by Dr. A. F. Woods, director of scientific work. This committee, whose object it is to determine what aid the various bureaus of the department may give in the corn-borer control work, includes representatives of the Bureaus of Plant Industry, Public Roads, Animal Industry, Agricultural Economics, Dairy Industry, Extension Service, Chemistry and Soils and Entomology.

At Yale University, Professor Richard S. Lull, professor of paleontology and director of the Peabody Museum, has been appointed to fill the new Sterling professorship in paleontology, and Professor Ross G. Harrison, Bronson professor of comparative anatomy and director of the Osborn zoological laboratory, has been appointed to the Sterling professorship in biology. These appointments fill the new Sterling chairs given to the university recently by the trustees of Mr. Sterling's estate. Dr. Francis G. Blake, the John Slade Ely professor of medicine, becomes Sterling professor of medicine, succeeding Dr. Edward A. Park, who recently resigned.

Dr. Rufus Cole, director of the hospital of the Rockefeller Institute for Medical Research, has been appointed to membership on the New York Commission on Ventilation, of which Dr. C.-E. A. Winslow, professor of public health in Yale University, is chairman.

Dr. Carl Ten Broeck, professor of bacteriology at the Peking Union Medical College, China, has been elected a member of the board of scientific directors of the Rockefeller Institute for Medical Research.

Dr. John A. Hartwell has been chosen a trustee of the New York Academy of Medicine for the unexpired term of the late Dr. Walter B. James.

Dr. H. E. Barnard, president of the American Institute of Baking, has resigned. Mr. Henry Stude, president of the American Bakers' Association, has been asked by the chairman of the board of directors to serve as temporary head.

Dr. Albert R. Merz has been elected president of the Washington, D. C., chapter of the American Institute of Chemists, to fill the unexpired term of Professor Paul H. Brattain, resigned.

Dr. Henry G. Knight, dean of the college of agriculture and director of the experiment station of the University of West Virginia, Morgantown, who was recently appointed by Secretary Jardine as chief of the new Bureau of Chemistry and Soils, was formerly inducted into office on October 1.

Raymond T. Parkhurst, head of the poultry department of the University of Idaho Experiment Station, has been appointed director of the National Institute of Poultry Husbandry at the Harper Adams Agricultural College, Newport, England, rendered vacant by the resignation of Professor Willard C. Thompson in 1926.

Geo. Hume Smith has recently resigned his instructorship in botany at the University of Illinois to become a member of the staff of *Biological Abstracts*, the headquarters of which are at the University of Pennsylvania.

Charles J. Stuckey, who held the Porter fellowship of the American Physiological Society for the year 1926–1927, has accepted a position as research chemist at the research laboratories of Scott and Bowne, Bloomfield, N. J.

Dr. John Boswell Whitehead, professor of electrical engineering and dean of the school of engineering at the Johns Hopkins University, has returned from France, where he was serving as exchange professor in engineering and applied science during the past academic year. He visited the universities of Aix-Marseille, Grenoble, Lyon, Bordeaux, Toulouse, Caen, Lille, Strasbourg, Nancy and Paris, in each of which he delivered a series of lectures on dielectric theory and insulation. In Paris the lectures were delivered at the Sorbonne and at the Ecole Supérieure d'Electricité. The University of Nancy conferred on Dr. Whitehead its medal of honor.

Professor Charles E. Decker, paleontologist of the University of Oklahoma; Professor Leslie Spier, head of the department of anthropology, and Dr. Chas. N. Gould, director of the Oklahoma Geological Survey, recently visited the gravel beds near Frederick, in southwestern Oklahoma, which have recently yielded human artifacts found in connection with mammalian bones of early Pleistocene or late Pliocene age. The party was successful in discovering a section about three by five feet in size of the top part of the carapace of the ground sloth, Glyptotherium.

Dr. W. F. Foshag, of the division of mineralogy, U. S. National Museum, has returned after four months spent in the mining regions of Mexico, particularly in the states of Guanaguato, Zacatecas, Chihuahua, Durango and Sonora. Some thirty-five boxes of specimens, the result of the trip, have been received at the museum.

Professor Harry N. Eaton, of the department of geology, of Syracuse University, has returned after a year's leave of absence spent studying the structure of the smaller mountain ranges of the desert west of the Rocky Mountains.

Commander George Miller Dyott, who returned last spring from a trip of exploration along the River of Doubt in Central Brazil, is forming a new expedition to start in a few weeks for the unexplored jungle south of the Amazon.

Professor Hans Cloos, head of the department of geology of the University of Bonn, has been spending several weeks in America studying North American mountains. After having spent some weeks in the mountains of California and Nevada, studying especially the granite masses of the Yosemite valley, Dr. Cloos visited Oklahoma in order to familiarize himself

with the type of folding in the Arbuckle and Wichita Mountains.

In the last few weeks a number of eminent poultry authorities from various parts of the world, who attended the recent world poultry congress at Ottawa, Canada, have visited the United States, according to the *Official Record* of the U. S. Department of Agriculture, including Professor Salvator Castello, head of poultry work in Spain; Professor H. Ogiware, expert, Imperial Zootechnical Experiment Station, Chiba-shi, Japan; Professor E. T. Halnan, in charge poultry nutrition work, University of Cambridge, England; Dr. Fritz Pfenningstorff, Berlin, Germany; Dr. C. H. Van Gink, Voorburg, Holland; Professor Hugo Medina, Chilean Experiment Station, Santiago, Chile, and Captain Washington, England.

Miss M. Blackett, an investigator of the National Institute of Industrial Psychology of Great Britain, has been awarded a Laura Spelman Rockefeller Memorial Fellowship, and plans to spend a year in the study of psychology in the United States.

Dr. H. C. Sampson, of the Royal Botanical Gardens at Kew, London, is visiting Jamaica, under the auspices of the British Empire Marketing Board, in connection with plans to improve the products of the region.

Dr. Edward Francis, surgeon, of the Hygienic Laboratory of the United States Public Health Service, will deliver the first Harvey Society lecture at the New York Academy of Medicine on November 11. His subject will be "Tularemia."

Dr. Alonzo Taylor, director of food research at Stanford University, gave the Carpenter lecture at the New York Academy of Medicine on October 20. Dr. Taylor spoke on "The Present and Future Food Supply of the United States."

Dr. Richard B. Moore, dean of science at Purdue University, will address the regular meeting of the Chicago section of the American Chemical Society on October 21 on "The Story of Helium."

Dr. Evarts A. Graham, professor of surgery at the Washington University School of Medicine, St. Louis, has been selected to deliver the Shattuck lecture before the Massachusetts State Medical Society at Boston in 1928.

Sir William Bragg will deliver a lecture on "Crystallization" at the opening meeting of the 1927–28 session of the Institution of Chemical Engineers on October 28.

The Huxley lecture will be delivered at Charing Cross Hospital Medical School on November 24 by Sir Archibald Garrod, Regius professor of medicine in the University of Oxford, on "Diathesis."

A committee has been formed to prepare a memorial to Dr. Thomas W. Salmon, professor of psychiatry at Columbia University, and the first medical director of the National Committee for Mental Hygiene, who in August drowned while sailing on Long Island Sound.

The Institute of Tropical and Preventive Medicine, Chicago, has issued an appeal for funds to establish a Gorgas Memorial as a tribute to William Crawford Gorgas. President Coolidge has approved of the memorial plan and is honorary president of the proposed institute in memory of Mr. Gorgas. It is proposed to raise an endowment fund of at least $5,000,000.

Walter Reed Memorial Commission of the Medical Society of Virginia for the Encouragement of Research will dedicate as a national shrine at Belroi, Gloucester County, Virginia, the birthplace of Walter Reed.

A memorial window in memory of Dr. Francis D. Kelsey, professor of botany at Oberlin College from 1893 to 1897, has been placed in the First Congregational church, in Toledo.

As already noted in Science, a committee has been formed for the purpose of raising funds and erecting a monument to the late Dr. Fritz Müller, the well-known Brazilian naturalist. The monument is to be executed by the sculptor, F. W. Lobe, and will be placed at Blumenau, State of Sta. Catarina, Brazil, where Dr. Müller spent the greater part of his life. Members of the committee are: Dr. Victor Konder, minister of public roads; Dr. J. Boiteux, honorary president; Kurt Hering, president; Dr. Amadeu Luz, Otto Rothkohl, German consul; August Zittlow; Hans Lorenz and Conrado Balsini. Contributions are desired from American scientific men. These may be sent to Banco Germanico, São Paulo, Brazil, or to Dr. Waldo L. Schmitt, Smithsonian Institution, who will be glad to acknowledge and forward them.

Dr. Francis Weld Peabody, professor of medicine at Harvard University, died on October 13, aged forty-five years.

Dr. Frederick Leonard Washburn, professor of economic vertebrate zoology at the University of Minnesota, and state geologist from 1902 to 1918, died on October 15, aged sixty-seven years.

Professor A. Liversidge, F.R.S., emeritus professor of chemistry in the University of Sydney, died on September 26, aged seventy-nine years.

M. Emile Haug, *membre titulaire* of the section of mineralogy of the Paris Academy of Sciences, professor of geology at the Sorbonne and a past-presi-

ent of the Geological Society of France, died on ugust 28, aged sixty-six years.

THE one hundred and forty-seventh regular meeting f the American Physical Society will be held in hicago, at the Ryerson Physical Laboratory, on riday and Saturday, November 25 and 26.

THE American Psychological Association will hold s annual meeting at the Ohio State University, from Wednesday to Friday, December 28, 29 and 30, under he presidency of Dr. Harry L. Hollingworth, of Barnard College, Columbia University.

THE twenty-third annual meeting of the American Society of Tropical Medicine will be held in Boston, on October 21 and 22, in the amphitheater of building E, Harvard Medical School. Dr. George C. Shattuck, f the Harvard Medical School, is the president of he society.

WITH the opening of the 1927–28 session, the Brit-ish Institute of Metals takes possession of its new headquarters, which include an additional library and reading room, at 36 Victoria Street, London.

AT its recent annual meeting in Edinburgh, the rep-resentative body of the British Medical Association approved the recommendation of the council to hold the annual meeting in 1930 in Winnipeg, Canada. The annual meeting in 1929 will be in Manchester, England. At the Edinburgh meeting, Sir Robert W. Philip, professor of tuberculosis, University of Edin-burgh, and honorary physician to the king at Scot-land, was inducted into office as president of the asso-ciation for 1927–28. Sir Ewen McLean, gynecologist at the Cardiff Infirmary, was made president-elect; Dr. Charles O. Hawthorne, chairman of the represen-tative body, and Mr. Bishop Harman, treasurer.

THE Australasian Association for the Advancement of Science will meet at Hobart, Tasmania, in January, 1928.

AT the meeting of the International Horticultural Congress, which recently closed its sessions in Vienna, it was decided to refer the question of the creation of an independent bureau for congresses to the Interna-tional Institute for Agriculture at Rome. Great Britain's invitation to hold the 1930 congress in Lon-don was unanimously adopted.

THE Kaiser-Wilhelm Institute for Anthropology was inaugurated in Berlin-Dahlem on September 15 by Herr von Harnack, the president of the Kaiser-Wilhelm Gesellschaft. Professor Eugen Fisher, the director of the new institute, outlined the program. In addition to the anthropological department, there are others devoted to heredity and eugenics.

ACCORDING to *Museum News*, the North Sea aqua-rium of the State Biological Institute on the island of Helgoland has recently been opened to the public. The aquarium has about fifty large tanks and shows the complete fauna and flora of the North Sea.

OPENING exercises of the second session of the school of tropical medicine of the University of Porto Rico, under the auspices of Columbia University, were held on October 3 in the assembly room of the school. Dr. Henry J. Doerman, acting chancellor of the University of Porto Rico, spoke on the rôle of the school as a graduate department of the university. The director, Dr. R. A. Lambert, gave an address on "Modern Tendencies in Medical Education." Dr. Pedro N. Ortiz, commissioner of health and professor of hygiene and transmissible diseases, presided..

LOUIS B. KUPPENHEIMER has contributed the sum of $250,000 to the University of Chicago to establish "The Louis B. and Emma M. Kuppenheimer Founda-tion." The income derived from this fund is to be devoted to the study of the structure, functions and diseases of the eye, and to the support of the clinical, research and teaching activities of its department of ophthalmology.

DR. G. A. TALBERT, head of the department of physiology at the University of North Dakota Medical School, was a recipient of a grant of $300 the past year from the American Medical Association Research Fund. With this aid Dr. Talbert and his students were able to further pursue their research on the study of the constituents of the sweat, urine and blood, also gastric acidity and other manifestations resulting from sweating.

ACCORDING to the Italian correspondent of the *Journal* of the American Medical Association, the in-stitute of general pathology of the University of Genoa recently received a legacy of several million liras from the estate of Dr. Mangiamarchi, who died at Pretoria, Transvaal. By testamentary provision, the bequest must be devoted to the development of the new institute that was opened last year.

ON September 24 the R. R. S. *Discovery* anchored in Falmouth Harbor, England, having completed a two years' cruise to Cape Town, South Georgia and the Falkland Islands; she was expected to arrive in the Thames on October 1. The primary object in fitting out the *Discovery* expedition was the investiga-tion of the southern whaling fisheries. It is expected that the scientific staff will spend some months ashore working up the results of the expedition, and that these will prove of great value to science and to the whaling industry.

DR. LUDLOW J. WEEKS, of the Canadian Geological Survey, Department of Mines, and an assistant, Mr. Maurice H. Haycock, of Wolfville, Nova Scotia, accompanied the 1926 Canadian Arctic expedition as far as Baffin Island and returned on this year's patrol ship. After establishing headquarters at Pangnirtung in 1926 several trips were made around the head of Cumberland Gulf and a plane-table map of Pangnirtung fiord was completed before the 1926–27 winter set in. During the winter and the following spring approximately 2,300 miles were covered by sled and dog team. By this means the party was able to map the northern part of Cumberland Gulf, and in the spring, to investigate the geology and mineral possibilities of the region. Early in May the party moved to Nettilling fiord and, after the break-up in July, a start was made on the journey by water to Nettilling Lake. The party succeeded in carrying a traverse from Nettilling fiord through a chain of small lakes to Nettilling Lake and along the south shore of the latter.

UNIVERSITY AND EDUCATIONAL NOTES

BY the will of the late Annie Downing Willson, of Cambridge, the sum of $150,000 is left in trust to Harvard University, the income of which is to be used to maintain a professorship of applied astronomy in the university.

THE will of Robert Forsyth, consulting engineer of Chicago, bequeaths $100,000 to the Rensselaer Polytechnic Institute of Troy, N. Y.

THE University of Rochester will receive from the estate of James M. Cutler, former mayor, property valued at $2,407,151, to be used as a permanent endowment. $55,486.41 was set aside by Mr. Cutler for the College of William and Mary at Williamsburg, Va.

DR. G. CARL HUBER, professor of anatomy and histology in the University of Michigan since 1892, has been made dean of the graduate school of the University of Michigan, succeeding the late Professor Alfred H. Lloyd, who died last spring.

DR. A. W. STEARNS has been appointed dean and associate professor of neurology at the Tufts Medical School.

DR. CHARLES ALLEN PORTER, John Homans professor of surgery at the Harvard Medical School, has resigned. Dr. Porter's successor will be Dr. Edward Peirson Richardson, now assistant professor of surgery in the school.

PROFESSOR J. R. DUPRIEST, head of the department of mechanical engineering at Oregon State College, recently accepted a similar position at the University of Minnesota.

DR. L. B. NICE has resigned as professor of physiology at the University of Oklahoma, in order to accept an appointment as professor of physiology at Ohio State University.

PROFESSOR I. M. KOLTHOFF, of the University of Utrecht, Holland, has been appointed professor of analytical chemistry at the University of Minnesota for the coming year. He is to replace Professor P. H. M. P. Brinton, who recently resigned to do private work.

DR. LEON H. STRONG, formerly assistant professor of anatomy at the University of Indiana, has been appointed associate professor of anatomy at the University of Utah School of Medicine. Dr. O. A. Ogilvie (M.D., Penn. '27) has been appointed assistant professor of anatomy and pathology in the same school.

DR. NOEL F. SHAMBAUGH, former fellow in medicine of the National Research Council, upon his return from Berne, Switzerland, was appointed assistant professor of clinical investigation in the department of internal medicine of the University of Michigan.

DR. WILLIAM A. P. GRAHAM, instructor in geology at the University of Iowa, has been made associate professor of geology at Texas Technological College. Dr. M. A. Stainbrook, instructor in the University of Tennessee, has been made assistant professor of geology in the college.

DR. WILLIAM H. ADOLPH, formerly of Chee-Loo University, China, last year at Yale University, has been appointed to an associate professorship of chemistry in the University of Nebraska.

DISCUSSION AND CORRESPONDENCE

A SUGGESTION OR HYPOTHESIS CONCERNING THE ZODIACAL LIGHT

THE nature or origin of the zodiacal light is regarded as more or less of a mystery. Some have thought that the phenomenon may indicate the existence of a diffused ring of small particles in equilibrium and in nature somewhat like those of Saturn's rings, though more scattered and existing in very small amount compared thereto.

This hypothesis assumes a stability which it is difficult to accord to such a ring.

If we assume, however, that the coronal streamers from the sun which apparently extend without limit of distance into space, as partly composed of or accompanied by fine particles propelled by the pressure of light, or even of fine solids from condensation

vapors arising from the solar atmosphere and panding into a vacuum external thereto, we may m a hypothesis which seems to be consistent with facts. The fine condensed particles would move o a vacuous space in substantially straight lines d would reach enormous distances from the solar dy. As the spectrum lines of iron are prominent solar light, it might be expected that in the space rrounding the sun fine particles of iron would con- tute, in part, at least, those escaping streamers om the solar atmosphere. These particles would rround the earth and be extended in all directions erefrom.

If they be of the same or of similar nature to ose which in my experiments are seen to line up a magnetic field (the observations on the novel gneto-optical effect described in SCIENCE, June 24 d July 29, 1921) then the zodiacal light, which is en best at places near the equator and at times of rnal and autumnal equinoxes, might be explained as llows: The magnetic field lines of the earth joining

Fig. 1.

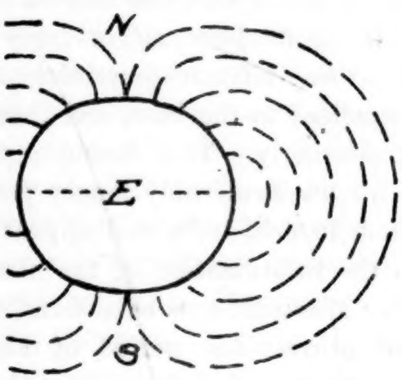
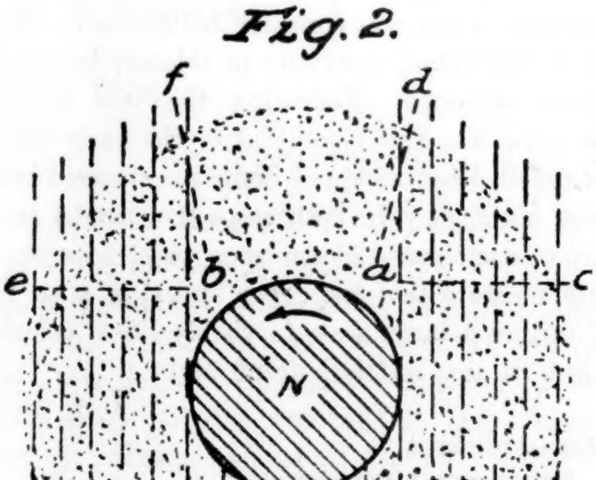


Fig. 2.



the north and south areas outside the earth would, at the equator, lie sensibly parallel to the earth's axis but at a great height, on the average, above the surface of the earth. This is illustrated in the subjoined figures, which indicates the general trend of the earth's magnetic field (one side only) all around the earth in the space about it.

The dots in Fig. 2 do not represent floating particles, but are intended to show only that if one could look at a pole of the earth from a great distance and see a section through the equatorial plane, the lines of force of Fig. 1 might be indicated as dots in the equatorial plane. Now, let the sun's rays be from below, it will be seen that they intersect the direction of the magnetic lines at nearly right angles. Now, further, let us by some means render visible in the polar beam the magnetic field about the earth, it will become apparent that it will be best seen by observers after twilight at night and before twilight in the morning—best at the time of the equinoxes and best in the tropical night. On the average the observer placed at about *a* or *b* looking upward, will be well placed for such observation and the column of light will extend from *c* to *d* on the evening side, and from *e* to *f* on the morning side, or over an angle of about 60° altitude, more or less.

It may, therefore, appear as a plausible hypothesis that the luminous effect known as the zodiacal light or the "Gegenschein" may be of the same nature as that observed in the combination of magnetic field, light beam and iron smoke from an arc, as described in 1921 in SCIENCE, as above. If the zodiacal light is polarized in the same way as the light from the iron smoke is polarized and undergoes the same variations by variations in the direction of viewing it, these circumstances might assist in identification.

There has been no opportunity to make any observations on this point. As the luminosity of the zodiacal light is low, although coming from a great depth of space around the earth, there would not need to exist for producing the effect more than an exceedingly small density in the iron particles concerned, a density perhaps millions of times less than in my original experiments on the magneto-optical effect. It has been shown also that the orientation which is the cause of increased luminosity in the light beam is producible by a very weak magnetic field. That the direction of viewing is transverse to that of the light beam, and that the magnetic field lines are transverse both to the directions of viewing and light beam, are significant facts. More and varied observations and experiments are certainly warranted in this fascinating field.

It will be seen that the hypothesis presented does

not require any ring formation around the earth. It requires only that the general space surrounding the sun and planets contain an exceedingly small density of diffused iron particles, capable of being affected or oriented when in the magnetic field surrounding the earth, in which case they reflect the light of the sun to observers on the earth who are in favored relation to them. Moreover, it may well be that the magnetism of the earth would tend to concentrate such iron particles, if any, in the space around it. If we have found a clue to the observed effects, further observations and investigations may confirm or oppose the hypothesis presented.

Elihu Thomson

Lynn, Mass.

THE PHYSICS QUADRILATERAL

One of the joys of a teacher in a university is the weekly colloquium or departmental meeting in which by cooperation he is able to keep fairly well informed as to the work that is being done in his special line. In the average American college, however, where the teachers are few and the duties numerous, a weekly or even a monthly colloquium is hardly practicable. Especially is this true in a subject like physics, where a considerable mathematical equipment is necessary, and consequently the reading of an average article in a physical journal is laborious and often impossible for a college student. So his contribution to a colloquium is nearly negligible and most of the burden falls on the professors. The natural result is that the colloquium idea is given up and the few members of the physics staff despair of being able to keep in touch with what is going on.

To remedy such a condition in this vicinity the following plan was adopted two years ago: The teachers of physics in the four colleges, Mount Holyoke, Smith, Massachusetts Agricultural and Amherst, established "The Physics Quadrilateral." President Olds, of Amherst, who had studied under Helmholtz, Kirchhoff and Quincke, was added to our membership. The first meeting was held at Amherst and was addressed by Dr. Gladys A. Anslow, of Smith. A discussion followed and then refreshments. Other meetings were held in rotation at intervals of about a month at the other colleges. The Quadrilateral's only officer is a secretary, and the program is usually arranged by the department of the college at which the meeting is held. The feature of one of our recent meetings was an address by Professor Louis V. King, of McGill University, on "The Gyromagnetic Electron and a Classical Theory of Atomic Structure and Radiation." The final meeting of the first year took the form of an excursion to the high-tension laboratory and plant of the General Electric Company at Pittsfield.

It is scarcely necessary to add that The Quadril eral is a source of benefit and pleasure to all its me bers, and this communication is written that other c leges similarly situated may pool their resources a reap similar reward.

Joseph O. Thompson

Amherst College

THE POISONING OF HONEY BEES BY COM MON ORCHARD SPRAYS

Recent studies made by the Massachusetts Agr cultural Experiment Station have indicated that the is little danger of significant mortality of honey be from the spraying of orchards, provided that t recommended combination of lead arsenate, lim sulfur and nicotine sulfate is used.

In laboratory tests, bees were strongly repelled b this regular spray combination (lead arsenate, 1 lbs. to 50 gals.; lime-sulfur, 1:40; and nicotine su fate, 1:1,000). This mixture, however, even whe consumed in minute amounts, proved to be very tox to them and was rapid in its killing action. Lea arsenate spray was readily accepted. A one-fram nucleus to which this was offered lost approximatel one half of its bees within forty-eight hours aft feeding. Any mixture containing nicotine sulfate w very repellent to the bees, and they would feed upo it but sparingly. This strong repellent action pe sisted for a considerably longer period in the labora tory than in field tests, and appeared to vary accord ing to the volatilization of the nicotine.

Under Massachusetts conditions, the orchard spray applied nearest the period of bloom are the pin and the calyx. No sprays are scheduled to be mad when trees are in full bloom. Neither of these spray made when there was considerable bloom on the trees caused any serious mortality to colonies located in th sprayed orchards. Following the late pink, tree soon came into full bloom; after the early calyx, th bees repelled by the spray doubtless foraged in neigh boring orchards. In both cases they found an abun dance of unpoisoned bloom upon which to work. Thi would indicate that improper spraying must be car ried out on a large scale to visibly affect colonies no subject to any restrictions of flight.

A. I. Bourne

Massachusetts
Agricultural College

ACOUSTICS IN THE STUDY OF "SOLUTIONS"

While stirring a dose of Epsom salts in water fo a patient I noted that if I strike the container (glass) with the mixer (a glass rod) at regular inter vals until the solute is entirely dissolved, each strok

will emit a musical note which at first with each succeeding note will become lower. I usually count four or five notes—less than an octave. When a certain point in the solution is reached the reverse takes place, namely, that the musical notes will become higher and higher until the solute is entirely dissolved or reaches a point of saturation. I repeated the experiment a number of times and found that between the first contact of the above solute with the solvent until solution or saturation has been effected I could distinguish a change in the scale about three or four octaves. Salt, sodium citrate and ammonium chloride will produce the same effect while undergoing solution. Sugar and sodium phosphate does not produce any difference in the musical notes whatsoever.

Further experiments with Epsom salts disclosed, to my surprise and astonishment, the fact that there are in the market two kinds of Epsom salts; one which will emit musical notes during the solution and another will not. Whether there is a difference in the crystalline form of these salts I do not know. It reminded me of the story of Pasteur's work on the asymmetry which characterized the tartrates of many substances. I have demonstrated this phenomenon before many physicians and druggists and none of them, they all assured me, have ever noticed it before.

Have I been the first man to hear these sounds? I dare not presume that this simple phenomenon has never been observed before. I wonder, however, whether the research workers on the subject of "Solutions" have utilized this acoustic phenomenon in their work and whether there is any literature on this subject. The available literature in our public and medical libraries has no reference to this subject. If my observations are correct, then a new field for research is open for investigation.

C. D. Spivak

Denver, Colo.

QUOTATIONS

THE MARCH TO HEALTH

The decennial supplement of the *Registrar-General* contains a new national life-table for England and Wales. This table is the work of the government actuary, Sir Alfred Watson, and is based on the figures of the population returned in the 1921 census and on the average number of deaths recorded in the three years 1920, 1921 and 1922. The new table confirms the opinion which is generally held, that "the vitality of the nation has been steadily improving." A rough measure of the improvement is afforded by a comparison of the "expectation of life" as indicated in the life-tables of 1906, 1911 and 1921 (the new table), respectively. In 1906 a male child at birth had an expectation of life of 48.53 years. In 1911 the expectation of life at birth had risen to 51.50 years. The new table gives an expectation of life of 55.62 years. The figures relating to female children at birth are, respectively, 52.38, 55.35 and 59.58. It is pointed out in the report that improvement in the rate of mortality is specially marked at the youngest ages. The probability of a child's dying in the first year of life, for example, has decreased by about forty per cent. during the fifteen years between 1906 and 1921. Curiously enough an appreciable deterioration has occurred in the rate of mortality of women between the ages of eighteen and twenty-seven. This deterioration, however, does not affect married women. It may be that, in recent years, young women have been engaging in tasks which impose too great a strain upon their physical constitutions; in any case, it seems possible that woman's place in the industrial and commercial worlds can not be determined solely by woman's enthusiasm to enter and share these worlds. A further commentary on woman's strength as a worker and wage-earner may possibly be afforded by the fact that rates of mortality are invariably heavier among widows than among single women or wives. The report deals at considerable length with mortality in different geographical areas of the country and confirms the prevailing view that the rate of mortality varies both with the geographical distribution of the people and with the density of the population. But of these two the geographical is the preponderating influence. In all the areas examined the difference between the death-rate of county boroughs and that of rural districts is greater among males than among females, but the point is emphasized that this difference does not appear to be due to the greater strain of working conditions to which men are subjected, but to the relatively favorable mortality experience of the male population of rural areas. The healthy conditions of country life, in other words, are enjoyed to a greater extent by men than by women, whereas in towns the two sexes are subjected, as a general rule, to the same kinds of conditions.—*The London Times*.

SCIENTIFIC BOOKS

Fogs and Clouds. By William J. Humphreys. Baltimore, The Williams and Wilkins Company, 1926. 98 pp. of text, 93 illus.

Of the text, one may enthusiastically say that if laymen could avail themselves of the privilege of reading Dr. Humphreys's lucid account of how these fogs and clouds come into and pass out of being, of the everchanging play of atmospheric processes that control their everchanging forms, a widespread intelligent interest in them might soon be expected. The book is in its author's best style. There is about

the descriptive matter often a deftness of touch which is altogether delightful. This is a "popular" work; but it suffers from none of those elements of vulgarization that too frequently creep into the "popular science" writing of this day. It is a book to be heartily commended to the teacher who strives for scrupulous accuracy in the non-mathematical presentation of scientific things.

The publisher says on the jacket of the book that it contains "the largest and finest collection of cloud photographs ever presented in one volume." One must express surprise at this encomium. The illustrations are good, on the whole; some of them are very good; a scant few of them possess the almost stereoscopic loveliness in the halftone rendering of form and depth and distance, which is an outstanding characteristic of some recent foreign cloud books.

The clouds presented as types are in a few cases disappointing. It would be difficult indeed for all to agree on the choice of the picture intended to illustrate a given type. For instance, Figure 33, "Strato-cumulus, Roll Type," seems to the reviewer to present nothing more than a good cumulus cloudscape with the usual receding glimpses of the bases of ever more distant clouds. The well-formed cumuli in the nearer distance appear to indicate that conditions weren't right for roll-type cumuli just then. The strato-cumulus in Figure 34, on the other hand, could scarcely be finer. Figure 41, "Cumulus," pictures very prettily the grounds of the U. S. Department of Agriculture in Washington. In Figure 42 the sky is quite too crowded with irregularly disposed cumulus bases to leave any just impression of the *en echelon* arrangement it was desired to portray.

Such comments relate after all, however, to failings which are not of major importance. One will have to go far to find a volume more serviceable to its purpose, or better adapted to making us familiar with the names and habits and vagaries of form of these transient visitors to our skies.

B. M. VARNEY

DEPARTMENT OF GEOGRAPHY,
THE UNIVERSITY OF CALIFORNIA AT LOS ANGELES

SPECIAL ARTICLES

THYROXIN AND COAT COLOR IN DILUTE RACES OF MICE AND RATS[1]

IN the course of investigations of thyroid function, begun in 1921 on the domestic fowl, one of the most striking effects of experimental hyperthyroidism to be observed was the darkening of the plumage in such pigmented races as Rhode Island Reds, Barred Plymouth Rocks, Silver Campines and Brown Leghorns.[2] The addition of desiccated thyroid to the dietary of growing chicks, and the parenteral injection of thyroxin itself, led quickly to an increase both in quantity and extent of plumage melanins. This not only revealed a definite influence of the thyroid hormone on melanin production in these birds, but suggested a possible means of exploration by thyroxin of the pigment-forming mechanism itself, not only in birds but in mammals as well.

Accordingly, experiments were begun on several color varieties of mice and rats. Representatives of six varieties of mice, namely, piebald, pink-eyed, chocolate, dilute chocolate, dilute black and albino, and one variety of rat, namely, dilute black-hooded, received systematic abdominal injections of thyroxin. The dose for all ages was approximately 1 mgm. of thyroxin to every 500 grams of body weight, administered at intervals of three or four days. Interest centered chiefly about the behavior of naked or nearly naked young, to which thyroxin could be given as the coat developed from birth onward. When adults were given thyroxin, a patch of hair was clipped from the rump in each case.

In sharp contrast with the response of the domestic fowl, the administration of thyroxin under the conditions of the experiments produced no effect whatever on the coat color of the rats and mice, young and old. The facts will be sufficiently established by a brief review of four typical experiments.

1. To 5 dilute chocolates, 2 dilute blacks, and 6 piebalds, all well grown, thyroxin was administered as follows:

June	28	.03 mgm. each	
	30	.03 " "	
July	2	.03 " "	
	5	.04 " "	Hair clipped from area on rump.
	9	.04 " "	
	14	.05 " "	
	16	.05 " "	
	19	.05 " "	
	21	.05 " "	
	23	.05 " "	
	26	.05 " "	
	28	.05 " "	
	30	.05 " "	
	2	.05 " "	
	6	.06 " "	
	9	.10 " "	Injections discontinued.

In none of these animals, either during the period

[1] This inquiry was aided by a grant from the Carnegie Institution of Washington. The stock used was obtained through the kindness of Dr. W. E. Castle and Dr. M. R. Curtis.

[2] Anat. Rec., xxiv, 395; Proc. Soc. Exp. Biol. Med., xxiii, 536; Biol. Bull., in press.

of the injections or for six months thereafter, were any changes noted in the coat color that could be attributed to thyroxin.

2. To 1 albino and 5 chocolate mice, forming one litter from a chocolate mother and weighing about 3 gms. each, thyroxin was administered as follows:

June 24	.005 mgm. each		
28	.006 " "		
30	.006 " "		
July 2	.012 " "		
5	.016 " "		Hair clipped from rump area.
9	.020 " "		
10	.024 " "		
14	.030 " "		
16	.030 " "		
19	.030 " "		
21	.030 " "		
23	.030 " "		1 chocolate died.
26	.036 " "		1 chocolate died.
28	.036 " "		1 chocolate died.
30	.036 " "		
Aug. 2	.040 " "		
6	.050 " "		
9	.060 " "		Injections discontinued.

As in the case of the adults just considered, thyroxin produced no apparent effect on coat color of either chocolate or albino during or after the series of injections.

3. To 5 dilute black-hooded rats, of the same litter, weighing about 15 gms. each, with eyes unopened, hooded pattern visible, hair very short except for a few long hairs, thyroxin was given as follows:

April 24	.05 mgm. each	
30	.05 " "	Hair well out. Pattern marked.
May 6	.05 " "	
12	.05 " "	
7	.05 " "	Injections discontinued.

Results as in the preceding cases.

4. To 5 dilute black-hooded rats, weighing about 6 gms. each, and naked, thyroxin was given as follows:

June 24	.008 mgm. each	
28	.010 " "	
30	.010 " "	
July 2	.014 " "	2 dead
5	.018 " "	1 dead
9	.024 " "	
10	.026 " "	
14	.034 " "	
16	.040 " "	
19	.040 " "	
21	.044 " "	
23	.050 " "	
26	.050 " "	
28	.050 " "	
30	.050 " "	Injections discontinued.

Results as in preceding cases.

This failure of the mice and rats to respond to thyroxin indicates a marked difference between the mechanisms involved in feather and hair pigmentation in the birds and mammals observed. Large amoebid melanophores play a peculiar and conspicuous rôle in the development and distribution of feather melanin, a process that appears to have no counterpart in the developing hair. It is unlikely, however, that this or any other such histological difference is of fundamental importance in this connection. The simplest assumption to account for the observed facts is that these unresponsive varieties do not possess the factors essential, with or without thyroxin, to a deepening of their coat color beyond its typical limit. Dilute chocolate and dilute black do not appear merely as less intense color varieties of chocolate and black respectively, but differ from the latter in the absence of factor or factors necessary to the production of their characteristic coloring. The result of the physiological test with thyroxin thus accords with the well-known facts of their genetic behavior and current conceptions of their genetic constitution.

HARRY BEAL TORREY

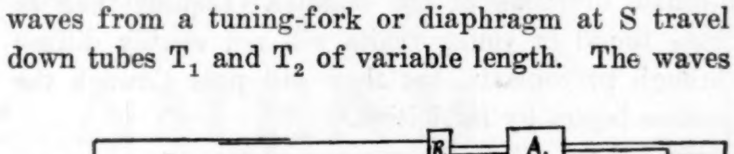
ON THE VELOCITY OF SOUND

THE velocity of sound as a function of tube diameter has received consideration from time to time. Helmholtz, in 1863, proposed, without demonstration, the following as the governing relative,

$$V = V_0 \left(1 - \frac{c}{d\sqrt{n}}\right)$$

where V_0 is the velocity in free air at 0° C., d is the diameter of the tube, n the frequency and c a constant. Later Rayleigh derived this relation from certain dynamical considerations but the experimental support for it has been meager and not satisfactory, due to lack of sufficient accuracy in velocity measurements.

Some years ago, Wold carried out some measurements by a method illustrated in the figure. Sound-waves from a tuning-fork or diaphragm at S travel down tubes T_1 and T_2 of variable length. The waves



are picked up by receivers R_1 and R_2 of the condenser transmitter type. The outputs are amplified by six stage amplifiers A_1 and A_2 and impressed on

the orthogonal pairs of plates of a low voltage Braun oscillograph tube. The Lissajous figure resulting can be brought to a straight line by adjustment of one of the tubes. If now one tube is gradually changed in length through one wave-length, the figure will pass through its elliptical cycle back to a straight line. This method of finding wave-length has shown itself capable of a surprisingly high degree of accuracy.

Recently, we have repeated the work with refinements as to frequency and temperature control and corrections for humidity. The attempt has been made to reach an accuracy of one part in ten thousand, but this has not been attained as yet, probably due to the effects of reflected components of the waves within the system. These have been greatly reduced but not entirely eliminated. The results thus far obtained, using brass tubing, seem to confirm Helmholtz's relation and are best represented by the following:

$$V = 331.4\left(1 - \frac{4.45}{d\ n^{.53}}\right)\frac{\text{meters}}{\text{sec}}$$

P. I. Wold,
Geo. R. Stibitz

Union College,
Schenectady, New York

WATER TRANSLOCATION IN YOUNG FRUITS[1]

Immature succulent fruits are essentially masses of meristematic tissue, although most of the protoplasts contain well-defined vacuoles. Their cells are everywhere in contact with neighboring cells, without interruptions by intercellular spaces. Almost universally these cell walls contain pectic (or related) substances which possess marked imbibitory properties. The purpose of this note is to emphasize a consequence of these conditions which is generally overlooked, namely, the importance of these hydrophilic layers in the translocation of water through the tissues. Our observations make it apparent that imbibed liquid passes over the surfaces of these cells, as well as through them by osmosis. The fibrovascular bundles furnish channels by which water and dissolved substances may enter the fruit, but the majority of the cells are at some distance from the ultimate divisions of the bundles. Liquids such as those found in young fruits will not readily diffuse through protoplasts, but they will pass through the pectose layers by imbibition.[2]

The tissues of the young fruits which we have examined are composed of parenchyma cells without intercellular spaces. Unchanged cellulose is found in the walls of these cells, especially in the peripheral regions, though in the deeper lying layers the cell walls frequently do not show the cellulose reaction. When sections of fresh material are treated with ruthenium oxychloride solution the cell walls become deep pink, thereby giving evidence of pectose. The reaction is particularly strong in sections of the mesocarp of lemons, the endocarp of walnuts, the exocarp of apples, and the pericarp of tomatoes and of *Carissa grandiflora*. The thick walls of these cells may be readily seen in sections of fresh material if a proper mounting solution is used, but it is necessary to use a liquid which does not mix with water. We have used xylol. If the sections are in contact with an excess of water the colloidal layers swell to such an extent that their boundaries are indistinct. If they are mounted in 95 per cent. alcohol the water may be so completely removed from the colloidal layers that their true thickness is not seen.

The rate of water movement in these fruits seems fairly rapid[3] and the fluctuations in size are in large measure dependent upon the amount of water held by the colloidal matter of the fruit. The distribution of water between the protoplast and its bounding wall doubtless is an expression of the equilibrium between the imbibitional power of the wall and the osmotic attraction exerted by the contents of the protoplast. When cell walls of wilted and turgid fruits are examined in xylol those of the wilted fruits show a marked decrease in thickness.

It is well known that the tissues of these and other immature fruits are rich enough in pectose to be valuable for the preparation of jellies and jams, but we wish to call attention to the occurrence of these hydrophilic layers in the cell walls, and to emphasize their importance as paths for the translocation of water.

H. S. Reed
E. T. Bartholomew

University of California

[1] Paper No. 170 University of California, Graduate School of Tropical Agriculture and Citrus Experiment Station, Riverside, California.

[2] Tupper-Carey, R. M., and J. H. Priestley. "The Composition of the Cell Wall at the Apical Meristem of Stem and Root." Proc. Roy. Soc. London B. 95: 109–131. 1923.

[3] Bartholomew, E. T. "Internal Decline of Lemons. III. Water Deficit in Lemon Fruits Caused by Excessive Leaf Evaporation." *Amer. Jour. Bot.* 13: 102–117. 1926.

MacDougal, D. T. "The Daily Course of Growth in Two Types of Fruit." Yearbook Carnegie Inst. Wash. 18: 69–70. 1919.

Haas, A. R. C. "Relation between Fruit Size and Abscission of Young Orange Fruits." *Bot. Gaz.* 83: 307–313. 1927.